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FOR MANAGERS OF INFORMATION TECHNOLOGY WORLDWIDE

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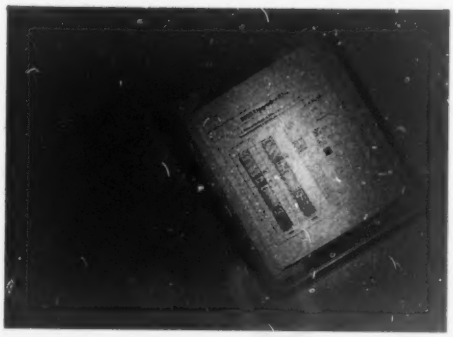

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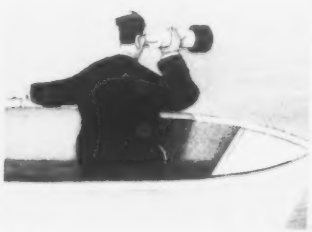

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Charting the Course of the Industry

Since the fall of 1976, DATAMATION and the prestigious Boston investment house Cowen & Co. have joined forces to appraise the buying intentions of computer users throughout the United States and Canada. Twice a year—in both the fall survey of mini- and microcomputer users and the spring survey of large-system sites—the partnership works to develop as clear a view as possible of where the dollars are going. Users vote with their dollars: their planned purchases point decisively to what technologies are desirable and when; what markets will be viable and for how long; and, in an overall sense, to the economics of our industry.

This is not to say that the data are not open to interpretation. We would worry if things were so simple. But over the course of the DATAMATION/Cowen & Co. union, a body of data and a confidence in those data have emerged. In many ways, the record of this 13-year data stream, if you will, adds up to one of the industry's only true navigational maps, charting the course of our industry's past, present and future.

Photograph by Liane Enkelis

SAN JOSE BUREAU MANAGER KERR: Finding the pulse of the industry.

In this issue's survey of large-systems users, written by San Jose Bureau manager Susan Kerr, a decidedly complex outlook emerges. The data reveal the first hazy images of a slowing demand for big iron MIPs and uncertain emotions concerning new technology.

"At the same time," Kerr writes in our cover story, "What's Developing in Large Systems?" (p. 18), "Big Blue is faced with an aging mainframe product line and no successor on the immediate horizon. This could be to the benefit of plug-compatible manufacturers, especially Amdahl Corp., which may see double-digit growth in processor shipments this year."

Add to these currents the data showing fairly positive overall budget growth and what this year's survey comes down to is this: some positive surface signs coupled with an underlying message that IBM and its competitors will have their work cut out for them as they try to stay the course in the year ahead.

And Stopping at Points Along the Way

Kerr takes a look at the management of divisional and departmental local area networks in another article in this issue, "Playing in Concert." What Kerr has discovered is that corporate IS would like to orchestrate the selection and management of LANs. But LAN users may have been hearing a different tune. Turn to our story on page 55 to hear the score.

To further excite your senses, our story on the U.S. Department of Agriculture's meat and poultry inspection system shows how the wrong system can be indigestible. Washington Bureau manager Willie Schatz reports in "Where's the Beef?" (p. 49) that the system has raised the ire of consumers, inspectors and industry.

And to complete our menu for this issue, senior writer Jeff Moad reports, in another installment of our continuing coverage of SAA, that IBM is crafting a series of industry-specific extensions to the architecture. What do the extensions mean for the systems originally left outside the SAA umbrella? What do they mean for various industries? To find out, turn to "Son of SAA" on page 39.

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What's Developing In Large Systems?

The 1989–1990 DATAMATION/Cowen & Co. user spending survey reveals relatively flat demand for large systems and hesitancy about new technologies like ESA and SAA.

BY SUSAN KERR

Getting a clear, accurate picture of user buying trends in the large-systems market is a bit like trying to predict luxury car sales, but what is beginning to come into view is more slowly growing demand for big iron MIPS and mixed emotions concerning new technology.

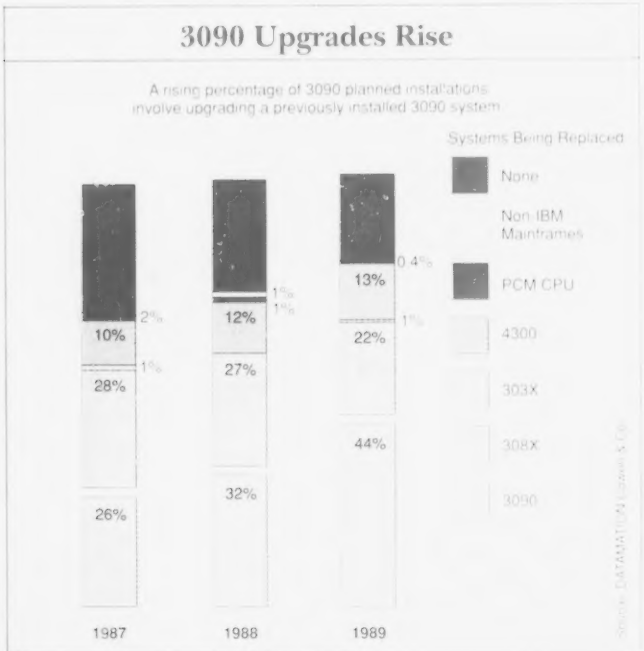
Sharpening those images, it becomes clear that the desire for IBM's MVS/ESA operating system and Systems Application Architecture (SAA) is less potent than originally thought. At the same time, Big Blue is faced with an aging mainframe product line and no successor on the immediate horizon. This could be to the benefit of plug-compatible manufacturers, especially Amdahl Corp., which may see double-digit growth in processor shipments this year.

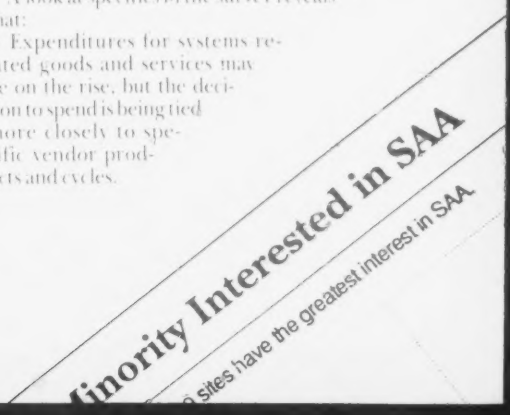
At Unisys Corp. sites, however, pent-up demand is evident from 1100/6-9X and A9/10 users, despite the continuing dissatisfaction among former Sperry Corp. users and new signs of discontent among A-series customers. MIPS-hungry Cray Research Inc. supercomputer users seem willing to wait and take their chances with future systems rather than jump on today's product bandwagon.

A market replete with many mixed signals and one increasingly dependent on product cycles and system upgrades rather than on outright systems replacement are just some of the conclusions drawn from the DATAMATION/Cowen & Co. Large and Midrange Systems User Survey. In its 12th year, the survey is a poll of more than 2,800 U.S. and Canadian customers of Cray, IBM, NCR Corp. and Unisys, seeking users' projected purchase plans and attitudes toward their vendors.

A look at specifics in the survey reveals that:

- Expenditures for systems related goods and services may be on the rise, but the decision to spend is being tied more closely to specific vendor products and cycles.





Broad-based migration to SAA is foreseen only among users of the newest IBM systems.

■ In terms of overall spending, the 1989 survey shows a rising, although still minority percentage, of respondents planning increases in their budgets. Of those projecting budget growth, the average planned per-site increase has more than doubled to 9.5% in 1989 from 4.5% in 1988. Spending increases may be a response to higher prices recently enacted by IBM, or they could be a signal of broader economic trends, such as inflation.

■ Despite last year's introduction of the Y-MP system, one-third of respondents at Cray sites are waiting for future systems. Demand for capacity at the low end of Cray's line is also less than spectacular.

■ The AS/400 is emerging as the bulwark of IBM's midrange systems business, although survey results raise questions as to its sales durability. IBM only began shipping it last August, but already the AS/400 accounts for nearly one-fifth of the respondent aggregate S/3X installed base in dollar terms. However, users report the possibility of a drop in new installations in the fourth quarter of 1989.

■ Demand for additional disk drive capacity remains strong across the board, with IBM sites showing the greatest interest in expanding storage. Fully 56% of IBM users indicate the need for more capacity, versus 50% at NCR and 43% at Unisys sites.

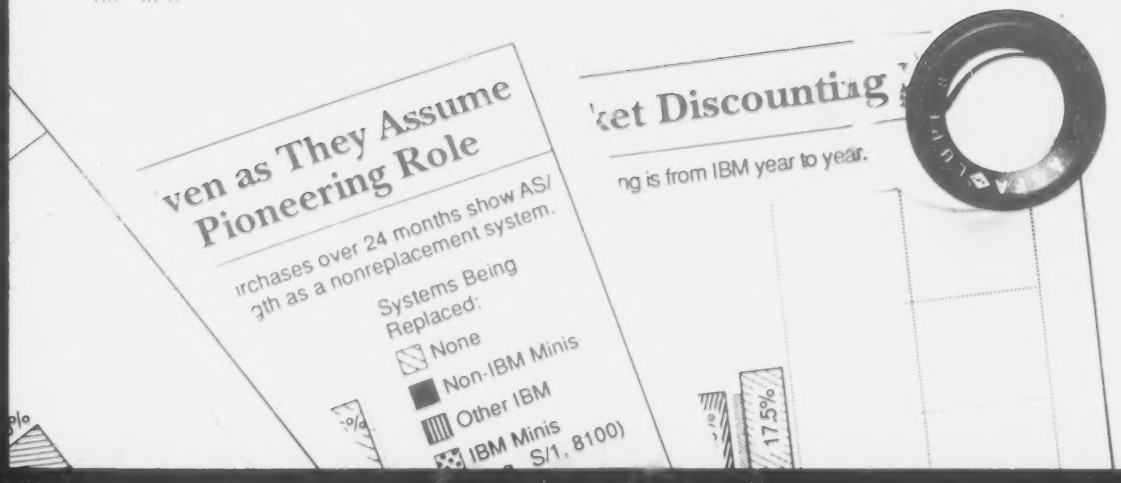
■ Only nominal 1989 unit shipment growth is projected for personal computers. Respondents' projections of OS/2 as their operating system of the future is still low.

For IBM users overall, prices for a number of IBM products and services were raised last July by 3 to 4%, which users most likely took into account when answering the survey. That's the good news for Big Blue. However, this March, after survey responses were in, IBM announced an additional 5% worldwide across-the-board price increase. That's bad news if customers are not prepared to expand their budgets to match the hikes.

And they may not be, because customers apparently feel they are already getting more bang for their buck from their existing systems, according to the survey. Users at IBM 3080 and 3090 sites, on average, expect the company's price per MIPS to decline 13.1% over the next three to five years. When asked to project spending over the same time frame, this class of customers says hardware budgets will increase at an average 7.4% annual rate. This is one-tenth of a percentage point below what last year's respondents indicated.

The drop may sound insignificant, but these numbers signal the reversal of a long-standing pattern. Projected hardware growth at high-end IBM sites now is lower than the overall survey average of 8% annual growth in hardware spending over the next five years. But the strong AS/400 numbers may be the culprit in tilting the lead away from IBM's mainframe base.

Is it possible that the lure of MIPS for big-systems users is fading ever so slightly? While the mainframe might not be dying, respondents at mainframe



sites report being comfortable with their current capacity. Only 32% of the organizations indicate that they will need more mainframe capacity to meet 1989–1990 requirements, down from 33% last year. A steady 35% of organizations report needing more departmental systems (the same percentage reported in last year's survey), but more than two out of three PC users continue to wait more capacity. The percentage of those reporting increased disk storage needs actually fell five points to 56%.

Translated into demand for MIPS, plans for 1989 show a dramatically slowing rate of increase. Total CPU power at 9370, 4300 and 30XX sites has grown 18% over the last five years. However, the average of 19.5 MIPS per site at all of these installations is only 6% more than was on hand last year. That number pales in comparison with the 26% MIPS hike that occurred between 1987 and 1988.

Responses concerning future MIPS needs may be more to the liking of vendors, despite signs of a slight tapering off. In last year's survey, mainframe users pegged their per-annum MIPS increase for the next three to five years at 18 to 27%. The range in the latest survey falls only a bit to 15 to 25%.

One reason for these high but diminishing expectations may be next-generation products. In a sharp shift, the vast majority (73%) of large-scale IBM systems users believe that the 3090 successor product, code-named Summit, will not appear until 1991 or later. Compare this with the 69% of users who last year believed that Summit would hit the world by 1990, if not sooner.

So, users are apparently making do with what they have. IBM has not been shy with product introductions to its current 3090 family, such as the Model S, unveiled last July. But despite contributing mightily to the profit stream, the 3090 is showing signs of age. If, as users believe, Summit is two years away, the Model S may not be the last 3090 we see. IBM may be forced next year to announce another end-of-the-life-cycle 3090 product.

> Responses concerning future MIPS needs may be more to the liking of vendors.

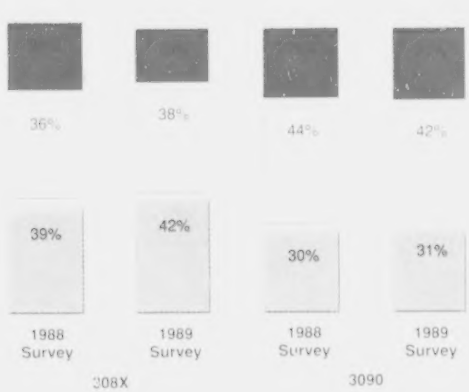
In general, a good chunk of mainframe users seem cautious about trying new things. Some of this apathy may be related to a natural reluctance to move into the unknown. Or it may be that IBM is not making the case for new offerings or directions. Certainly, neither MVS/ESA nor SAA is living up to its heralded beginnings.

MVS/ESA's acceptance rate may step up following some recent price cuts in storage and memory, which could bring down the cost of using the new operating system. Those price cuts were announced after the survey was completed. In the survey, more than 42% of MVS/XA users were already planning a conversion to MVS/ESA by year's end. As promising as this sounds, the number is only two-thirds of what was indicated in 1988.

Users of plug-compatible manufacturer (PCM) systems feel even less urgency to adopt MVS/ESA. Only 25% of users at PCM sites think the end of the year is the latest time acceptable for their suppliers to make

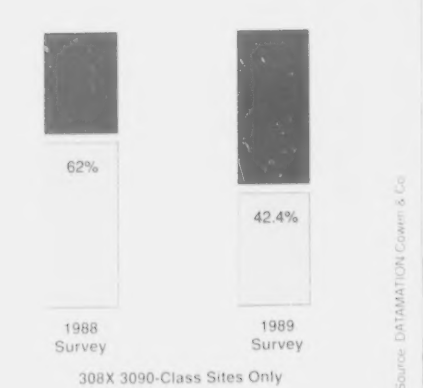
Interest in ESA Holding...

Larger percentage of 3090 users are interested in ESA, but a rising number of 308X 3090 users are hesitating



...But Cutover Moving More Slowly

Almost 19% more users say they will install ESA later than they said they would in 1988



Even those IBM users moving to SAA aren't very clear about what gains they'll be getting.

their products fully compatible with MVS/ESA. That falls into the time frame that PCM vendors have set for themselves.

What's To Be Gained From SAA?

And then there's SAA. Only one-third of all respondents at IBM sites are showing any interest in migrating to SAA. Broad-based migration to SAA is foreseen only among users of the newest IBM systems. Furthermore, half of the respondents at 3090E,S sites plan to migrate to SAA—as well as 63% of respondents at AS/400 sites, the first product to conform to SAA.

One reason for the disinterest is that even those IBM users moving to SAA aren't very clear about what gains they'll be getting. Asked how much SAA will help with their new-applications backlog, the respondents indicate little anticipation that SAA will dig them out.

Neither will packaged software. There is no evidence in the survey that users are shifting from in-house programming to packaged software, despite applications backlogs amounting to years. But don't cry for the software vendors; users are projecting a slightly slower, but still nice, 8.2% rate of increase for packaged software spending during the next three to five years.

The bad news for IBM is that this is the seventh year in a row that it's getting a smaller percentage of the money earmarked for packaged software. In 1989, the average IBM customer is spending 54% of his or her packaged software budget at IBM, down three points from last year.

This erosion comes at the same time that IBM is forced to deal with the 3090. As is expected with a five-year-old product, a rising percentage of 3090s are supplanting a previously installed sister product. Survey respondents report that 44% of this year's 3090s are upgrades for members of the same family, up from 32% last year. A shrinking though still significant number, 22%, of 3090s are replacing 3080s, and a small though rising number, 13%, are superseding 4300s. But one-fifth of this year's planned 3090s are not replacing anything, down from last year's 26% new installations.

This means that upgrades are king, a conclusion further borne out by the decline in the average 3090 price. It now stands at $2.7 million, which is $600,000 less than the amount users were willing to fork over in 1988.

Furthermore, the 3090 is doing a poor job of replacing non-IBM mainframes or plug-compatibles. Less than .5% of 3090s are kicking out other vendors' systems, compared with 2% in 1988. IBM has lost some of its high-end systems market share to Amdahl, which is now supplying 7.6% of the units in the 30XX mainframe class, up one percentage point from last year, the survey reveals. Market share for IBM and National Advanced Systems Inc. each fell less than a percentage point to 89.6% and 2.8%, respectively.

IBM may be on the defensive, if its more aggressive discounting steps are a clue. While its pricing incentives are still less generous than those offered by Amdahl and NAS, IBM granted users average discounts of almost 10% off list price, survey respondents report. But Amdahl and NAS discounts were roughly 17%.

Amdahl could be rewarded with double-digit growth in processor shipments this year. The PCM vendor's newer systems, the 5890 and 5990 models, seem to be well accepted by the market. While these two systems make up less than half of the company's current installed units, the survey reports, users expect them to account for a huge chunk of future activity. Of those Amdahl sites where future purchases are planned, half are expected to be 5890s and another 25% will be 5990s.

Budget Growth Starts To Climb

Undoubtedly, the good news in this year's DATAMATION/Cowen & Co. Large and Midrange Systems Survey is that data-processing budgets are expanding at the fastest rate since 1984. Budgets will rise an average 9.5%, more than double last year's increase. Nonetheless, the numbers appear to be selectively upbeat, particularly if economic factors are taken into account.

Spending for two areas is beginning to slacken: personal computers and teleprocessing equipment. Growing at a mere 5% annually, PC budgets, which grew the fastest of all categories in 1987 and the second fastest last year, this year slipped to dead last. Unit growth for PCs is even more dismal; those surveyed project only a 0.3% gain over last year. That's better than the 5% decline in PC unit shipments recorded this past summer in the DATAMATION/Cowen & Co. survey of minicomputer and microcomputer users. Teleprocessing equipment, although slowing, remains healthy with a still highly respectable 7.2% upward swing in projected spending.

The big gainers in this year's budgets, when compared with last year's outlays, are staff salaries (up 5.4%) and IBM CPUs/peripherals, up 5.2% (which almost matches exactly the price hikes IBM enacted last year). Spending for software packages has improved, too, with survey participants projecting spending increases of 6.9%.

Despite dollar gains, hardware and packaged software are losing some of their share of respondents' total budget outlays. Today they account for 40% of all DP budget money, down from 42% last year and 44% in 1987. Hardware still accounts for almost three times more budget money than packaged software. PCs are responsible for almost one-third of all hardware monies.

So, for what are people budgeting? The answer continues to be for other people. Obviously, neither technology nor even the much-hyped systems integration boom is lessening the dependence on in-house employees. Staff salaries are up, perhaps in anticipation of inflation, and for the second year in a row account for 41% of the average budget. Staffs also are not being displaced in favor of outside services. For 1989, those surveyed anticipate spending only 8% of their money for outside services, such as systems integration.

Even though its customer loyalty equals that of Amdahl's, NAS' future is somewhat cloudier, given its smaller installed base and the uncertainty it experienced before it was sold to current coowners Hitachi Ltd. and Electronic Data Systems Corp. earlier this year. But both PCMs have work to do. A full 12% of Amdahl and NAS users say that, when the time comes to replace their systems, they are planning to change vendors. While that number is high, in both cases it is slightly lower than it was last year.

Pent-Up Demand in the Unisys Base

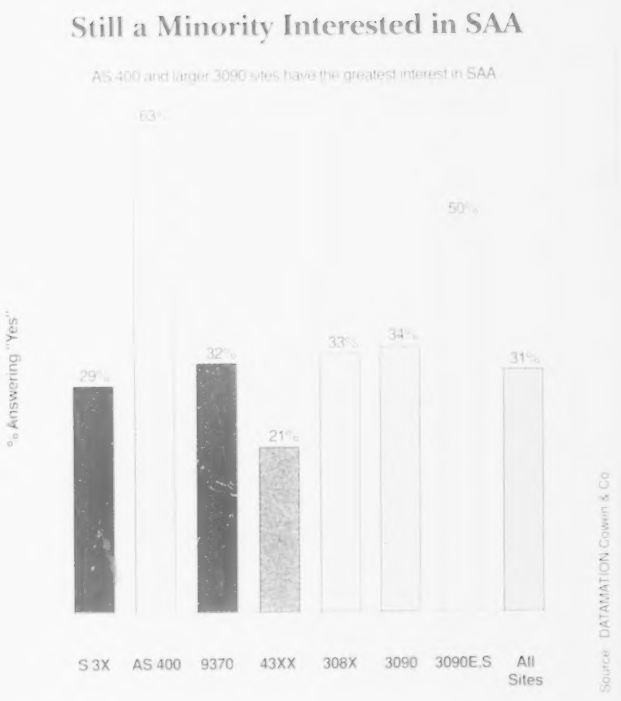
One out of six Unisys users are also looking for a change. Seventeen percent of all Unisys users this year are seriously considering switching vendors, down from 19% last year. As in previous years, applications package selection is still a significant reason for discontent.

Former Sperry users are somewhat less dissatisfied with Unisys than they were in 1988, although 37% of 1100 series users say their opinion has turned more negative in the past year. The highest level of discontent appears in the midrange 1100 6X-7X base, which is waiting for delivery of follow-on 2200 products in the second half of this year.

The former Burroughs Corp. base remains positive for the most part about Unisys, though there are indications of restlessness among A-series users. Thirty-three percent of large A-series customers say they have a more positive opinion of Unisys than they had last year, which is well below the 43% who gave the thumbs up in 1988.

On the bright side, unquestionably demand is there for new Unisys products. For example, 39% of the A 9–10 class users need more capacity, which is good news for the company, since Unisys has products coming down the line. Fifty-four percent of 1100 6X-7X users and 40% of 1100 8X-9X users surveyed plan to upgrade to the new 2200 systems. Of those not planning upgrades, nearly half say their present systems are fine for now, indicating future demand for Unisys.

However, it takes more than new pieces of hardware to stimulate growth; it takes new applications. The survey demonstrates the maturity of the market



Some Downward Pressure on Peripherals

If IBM ever spun off its peripherals business, the new company would immediately earn a place in the *Fortune* 100. Peripherals are that big a business.

Peripherals are also going IBM's way, judging by this year's DATAMATION/Cowen & Co. survey of purchasing expectations of large-scale systems users. Except for the tape drive segment, IBM is gaining market share in the peripherals business.

Yet, there is obviously some downward pressure on the business. Responses to the survey indicate that users at 30XX and 9370/43XX sites are less likely to install disk drives, tape drives or terminals in 1989 than they were in 1988.

Nonetheless, there is still quite a bit of activity, considering that 51% of the 30XX users and 42% of the 9370–43XX users have plans for new disk drives. Expectations are that terminals will be added to one out of three such sites, and additional tape drives are expected for 31% of 30XX, and 26% of 9370–43XX, sites.

As would be expected, users of IBM S/3X and AS/400 equipment run counter to the downward trend and are buying more peripherals than last year. Still, the planned activity is much lower than seen at large-systems sites. Only 10% of these midrange users plan to install new tape drives, 18% plan to add disk drives and 33% expect to purchase more terminals.

Despite some of the falling numbers, demand for additional disk drive capacity is highest at IBM sites. At least 56% of IBM users indicate the need for more capacity versus 43% at Unisys Corp. and 50% at NCR Corp. sites.

IBM seems to have recovered from its slip two years ago when it lost points in the 3380-class disk market. A look at planned disk drive acquisitions for 1988–1989 shows that IBM is gaining share primarily from National Advanced Systems Inc. Ninety percent of this year's respondents will turn to IBM, up from 87% in 1988 and 82% in 1987. Amdahl Corp. will hold steady at 3% and Storage Technology Corp. will drop from 3% to 2%. NAS is down from last year's 6% share to 1%.

Likewise, Big Blue is continuing its upward climb in sales of CRT terminals. Of those users planning to buy terminals between now and the end of 1990, 81% say they will choose IBM, compared with 75% in the 1988 survey. Memorex Telex Corp. and Idea Courier Inc. are both losing share.

for some applications but indicates growth opportunities for other products. Among IBM users, for example, word-processing software is growing at a mere 3% annual compound rate. Electronic mail, in contrast, is growing at a 20% rate and voice messaging is surging annually by 41%.

Who Craves Crays?

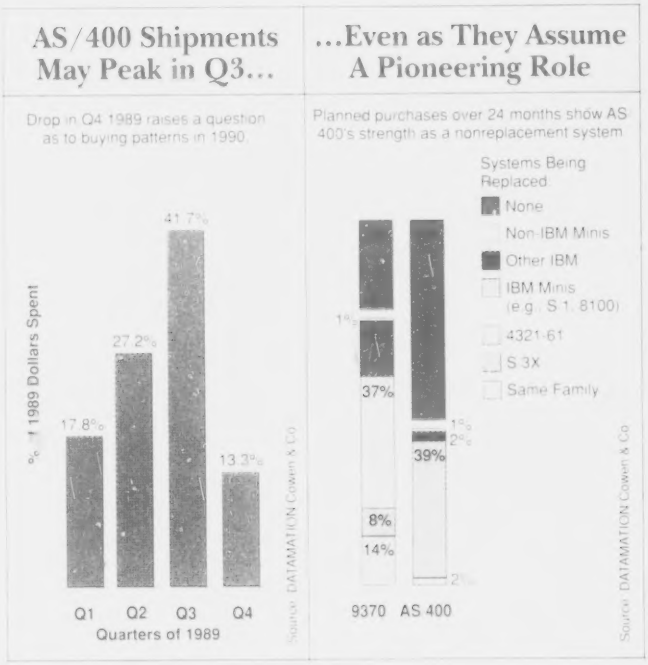
Meanwhile, the fast-paced evolution of technology is having an effect on Cray. This year's survey contains findings that could portend a protracted period of moderate shipment growth for the Minneapolis-based supercomputer supplier. Results indicate that Cray probably will have revenue growth in the 10% range this year, with 1990 showing only so-so gains.

The reasons are a combination of technology and budgets. Despite last year's unveiling of the Y-MP system, one-third of respondents at Cray X-MP/4 sites have altered installation plans to await future systems, namely the Cray-3 (due in 1990) and/or the C-90. Another one-third of these users are undecided.

The next-generation blues are also apparent at the low end of Cray's current base. More than 60% of the users of one- or two-processor X-MP systems claim to have no plans to install the new Y-MP systems. The reason? Again, one-third of these users are waiting for the next generation. But another third said they don't have the funds.

Other replies also indicate less-than-spectacular demand for more capacity at the low end. Seventeen percent of those with two-processor systems and 25% of single-processor users say they need more capacity in the 1989–1990 time frame. That number jumps to 60% of the four-processor base. Overall, combined responses from all sites indicate that the average percentage of users needing more capacity has dropped from 52% last year to 35% in this latest survey.

Software is also a big bugaboo for these Cray customers. Data base software is ranked as inferior by



What's Happening With the AS/400?

IBM undoubtedly is getting a real kick from its AS/400 midrange family, which should make 1989 a respectable year overall for the company and even the industry. Big Blue needs it, considering the rather pathetic showing of the 9370, the falling volumes of 4300 systems and the graying of the 3090.

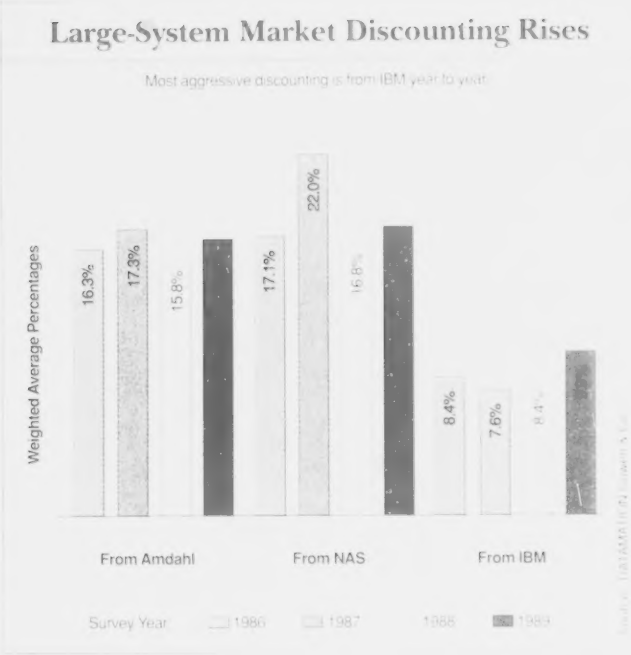
According to responses to the DATAMATION/Cowen & Co. survey of large and midrange systems spending projections, the makeup of IBM's midrange systems base will shift from today's leader, the 4300 (55.9%), to the AS/400, which should account for an overwhelming 74% of planned 1989–1990 installations. The 9370 will barely move a muscle, edging up from a 4.7% to a 5.8% share over the next 24 months.

Although neither the AS/400 nor the 9370 is successfully displacing competitors' equipment at respondents' sites, both are pulling in new dollars. Only 1% of those planning to install either IBM midrange system says the new units will be replacing a non-IBM mini. While roughly 40% of the AS/400s are supplanting S/3Xs, another 56% are not displacing any already-installed gear.

How long the upbeat news will last is hard to predict, but the numbers are not encouraging. Survey data predicting 1989 delivery installation projections on a quarterly basis show that IBM could have much of its 1989 potential AS/400 dollars in its pockets by the end of the third quarter. Only 13.3% of this year's AS/400 revenues are projected to come in the traditionally strong fourth quarter; however, the jury is still out on this issue, as customers for this class of gear ordinarily do not have their acquisition plans solidified nine to 12 months in advance of purchase. Furthermore, the survey results focus only on North America, not taking into account the strong AS/400 acceptance overseas, which represents two-thirds of IBM's S/3X base.

But it's impossible to discount the possibility that the AS/400 may have a short life ahead of it. Put into raw numbers, IBM shipped more than 25,000 AS/400s during the five-month period during which it was being delivered in 1988. Projections now call for Big Blue to ship approximately 50,000 units in 1989, meaning that, on an annualized basis, AS/400 shipments are down.

If these AS/400 predictions turn out to be true, that could spell longer term problems for IBM. Since the AS/400 appears to be the driving force behind many of this survey's positive results, IBM would need another near-term product to take up the slack. That seems improbable, as no other product line is likely to be replaced soon.



a hefty 43% of the users. Forty percent of the respondents say that operating systems need more attention from Cray. This is despite the broad migration to UNICOS, Cray's UNIX-based operating system. By year-end, 63% of the respondents say that they will have converted to UNICOS.

The weighted average annual supercomputer hardware budget growth for the next three to five years stands at only 9%. Of those users planning to install the new Y-MP systems, more than two-thirds will trade in current Cray systems.

On the plus side, estimates call for still healthy 24% growth this year in Cray's customer base. This growth could be considered a sign of relief from anticipated shipment pressures.

On the local area network scene, growth is strong but moderating. By year-end 1990, 54% of the respondents say, they'll have LANs, up from the 39% using the networks today. An increasing share of LANs are carrying the Big Blue label, but IBM remains the number two supplier after Provo, Utah-based Novell Inc. Through 1990, Novell is expected to provide 40%, and IBM 38%, of the respondents' planned local networks.

The PC Mainframe Connection

Overall, 31% of installed PCs are part of networks. And a staggering 95% of those surveyed say that by next year at least some of their company's PCs will be connected with central mainframes. Perhaps because of the demand networked PCs are placing on mainframes, 45% of surveyed users say that their PCs are increasing mainframe system workloads, up four percentage points from last year. A steady 10% expect PCs to decrease the load.

More than 20% of PC dollars in 1989 will go to enhancing older systems, survey participants report. Last year that number stood at only 9.3%. And for the first time since 1985, the survey shows IBM garnering a rising share of respondents' PC purchases. A little more than 52% of respondents' installed PCs are IBMs; plans call for 55.8% of PCs bought this year to come from Big Blue.

The losers appear to be Zenith Data Systems Corp., whose share of respondent purchases dropped by a third to 6.9%, and the nonidentified "other" category, which fell from 24.7% to 21.6%. This is good news for Apple Computer Inc. and COMPAQ Computer Corp., both of which show improvements, reaping a 10% and a 5.7% unit share, respectively. Compaq, however, appears to be making little headway with its alternative to IBM's Micro Channel bus, EISA. Forty-one percent of those responding believe that Micro Channel is the long-term favorite bus architecture, compared with 8.4% for EISA. Yet, the jury is still out, considering that more than a third had no opinion.

While the apparent lack of inroads by EISA is good news for IBM, the bad news is that projected usage of OS/2 as the future PC operating system is dramatically low at 15%. The old favorite, MS-DOS, is the operating system of choice for 79% of PC users.

Notwithstanding all the frenzy surrounding UNIX in recent months, it has a long way to go in the IBM world. In fact, at IBM mainframe sites, a slightly larger number of respondents, now 72%, up from 68%, say they have absolutely no interest whatsoever in UNIX. On the flip side, those very interested increased from 7 to 9% in the last year. Unisys mainframe users are more intrigued, with 19% expressing interest in UNIX versus 16% in 1988.

Unisys midrange users are more interested in UNIX than their IBM counterparts; 30% see the operating system is "very desirable," compared with 17% in the IBM world. More than half of the IBM midrange base indicates no interest in UNIX. IBM 9370 midrange users are the most interested in UNIX, the survey reveals, while, not surprisingly, users at AS/400 sites express the least interest. And, for the time being at least, the AS/400 is king of the IBM midrange world.

Survey Method

The 1989 DATAMATION/Cowen & Co. Large and Midrange Systems User Survey began during the week of January 9, 1989, when 53,585 questionnaires were mailed to mainframe systems users across the United States and Canada.

After eliminating invalid replies and multiple returns from the same user site, 2,835 completed questionnaires were tabulated. Of those, 2,288 were from IBM sites, 489 from Unisys Corp. sites, 38 from NCR Corp. sites and 20 from Cray Research Inc. sites. Respondents came from practically all segments of the economy, ranging from agriculture to transportation to nonprofit industries. The largest number of respondents came from seven fields: banking, business services, education, government, insurance, manufacturing and wholesale/retail businesses.

The Prototyping Conundrum

Prototyping is firmly rooted in a majority of development shops. It's often portrayed as a quick way to reduce software backlogs, but it's more often done to gain greater user satisfaction through improved requirements analysis.

BY J.M. CAREY AND J.D. CURREY

Prototyping: everyone wants to do it, but no one can quite agree what it is. Despite the popularity of the concept, there has been little or no consensus on the purpose of a prototype, its disposition, the benefits to be reaped or even how to conduct or control it.

Here are a few of the questions that need answers before prototyping can fulfill its promise:

What are the benefits of this development technique? To get something working quickly? To model requirements via throwaway screens? To build a permanent platform for later, more robust development?

Does prototyping actually reduce development time? Or the reverse?

How does a manager control the iterations? When is a prototype finished?

In an effort to answer these and other questions, in January 1989, we sent questionnaires to a sample of 250 companies, asking how they use prototyping as a development technique. Over 90 respondents cited experiences with more than 600 prototype development efforts.

While we do not suggest that this represents a statistically significant sample, the selected group is of value to trend-spotters because it represents a cross section of *Fortune* 500 and small firms, manufacturing and service organizations, profit and not-for-profit entities and public and private users.

This population allowed us to see if the prototyping phenomenon had settled in any one environment type. The answer to this question is no: prototyping occurs in all organizational structures, regardless of company type or size.

Only one prototyping factor related directly to a given kind of organization. That was average team size, which correlates directly to size of the IS function—number of analysts and programmers. Neither length of prototype duration nor availability of tools was related to size or type of organization. Similarly, prototype disposition was not related to the nature of the expanded business function.

Not everyone prototypes. About 25% of respondents said they had not yet begun to use prototyping techniques. But several of those say they plan to adopt prototyping techniques in the future. The nonprototypers described their reasons in various ways: "We don't prototype, we don't have the time" or "We have to bring up a system immediately" or "Our prototype is live."

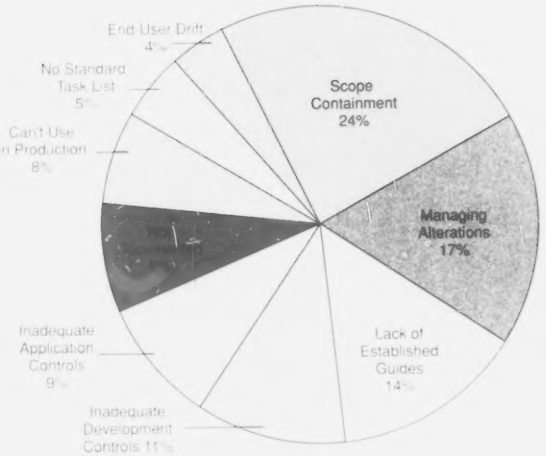
Another theme was rooted in definition. Many people believe they are not prototyping if the user doesn't sit alongside the technical developer. Several also indicated that building a system base or platform for later development might not be considered "real" prototyping.

The Attractions of Prototyping

Better User Involvement is the reason most often cited for prototyping

The Pitfalls of Prototyping

The biggest challenge is keeping the scope of the project under control



Source: Carey Project Organization

We noticed a strong tendency for people to downplay their prototyping experiences if they differed from the techniques espoused by popular industry theorists.

Still, most respondents prototype. Of those who do prototype, most indicated that they do so to gain the benefit of user involvement and to help users clarify requirements.

Most respondents were very clear about the benefits of prototyping. The overwhelming consideration in prototype development is the involvement of system users. Nearly all respondents cited user involvement among the top three benefits of prototyping. The word *user* appeared in 88% of the responses to the question, "What is the biggest difference between prototyping and traditional development?" Appearing with the word *user* were the words *see, feel, touch* and others with a "tangible results" connotation.

Defining True Requirements

From this emphasis on tangible results, we conclude that prototyping has become a way for the IS function to build, or model, the system in order to define requirements more accurately rather than more quickly. Prototyping is seen as the most efficient way of defining true specifications for the final application. Getting something working quickly is also an important benefit, ranked first slightly more often than defining requirements better, but the combined first and second place rankings (of a possible six places) rate speed well behind user involvement and better definition.

While more active user involvement is clearly the most significant difference in prototype development, it isn't always easy to maintain this involvement throughout the project. The need to manage customers' expectations is an imperative for successful prototyping.

The IS group also has the challenge of guarding against what William A. Cunningham, MIS director at Associated Press in New York City, calls "end-user drift." Several respondents described user frustration resulting from wanting to use the initial product as a production system; this was frequently encountered with the "toy model" approach.

When does prototyping become the best strategy? Interestingly, the most frequently encountered word in the open-ended response to this question was *all*, in two contexts: first, "all on-line development," and second, "all new development." The second most popular reason was to prototype when user expectations or requirements are not clear. Very few—less than 8%—employ risk or decision analysis criteria in deciding whether to prototype.

Respondents also suggest prototyping is typically used along with software development tools. Developers are using prototyping as a way to fully employ fourth-generation languages, data dictionaries, data bases and, to a lesser degree, computer-aided software engineering (CASE) tools. The most popular tools include high-level languages, with one-half reporting use of a 4GL. Mildly surprising was the comparatively low reported use of CASE tools: only one-fifth of the respondents who prototype say they use a CASE tool. Comments in this area suggest that the benefits of CASE technology are not yet cost-effective.

The second most popular software development tool is the data dictionary, which verifies the importance of data analysis and organization in prototyping.

The ranking of 4GL, data dictionary and screen painting tools in first, second and third places, respectively, suggests that organizations are using these three basic components to build their own CASE environments, rather than expending comparatively greater resources on all-in-one CASE tools.

Not surprisingly, respondents say the prototype most often evolves through successive iterations. Their second most frequent choice is to replace prototypes with new production code, although a whopping two-thirds use software that can be used in production. A few organizations do put the resulting applications into production as is.

Experience has led us to believe that prototyping bears a clear resemblance to classical research: while the desired results can and should be stated, the actual results may be surprising. In most cases, the plan is either to put the results into production after minimal enhancement or to use the results only as a model to be replaced by a production version.

However, it does occasionally happen that the prototype is tossed out, and the project as originally envisioned is abandoned. A clear insight into discarded results was voiced by one manager: "Either the users are happy with the first iteration or they lose interest." And, sometimes, the prototype slips into production by the back door when the original intent had been to replace it with more robust, efficient code.

Among those who prototype part or all of the development effort, strong patterns emerge, particularly in terms of the problems encountered. Most prominent are the struggles against creeping scope expansion and proliferation of the number and duration of prototype iterations. Problems also exist in the areas of both application and development controls.

Poor Documentation Exists

Moreover, prototype projects generally suffer from poor documentation or a total lack thereof. All of these can be related to a tendency to forgo the application of basic management methods. This may be the source of the widely held view that prototyping is the quick and dirty way to build a system product. The reported low use of estimating guidelines for faster, smaller development efforts is perceived to be a chief contributor to the

ensuing lack of control.

This lack of basic management controls is most probably rooted in the early uses of prototyping, which emerged at a time when large development methodologies were widely employed for traditional development projects. The attempt to combine the management aspects of these conservative development approaches with the more flexible, spontaneous approach required in prototyping appears to have failed, say survey respondents.

Combined with the expectation that prototype projects would last only a few weeks, this failure has caused many managers to decide against using standard management methods for prototyping. In fact, the average length of a prototype project reported in our survey is 4.25 months, which indicates that perhaps the trend away from application of management methods has swung as far as it can go, and it's now time to begin employing flexible, low-cost management methods that allow for successive iterations of the applications.

However, many practitioners agreed that controlling iterations and scope represents the crux of the problem. According to Edward Solarz, a systems development manager at Arco Chemical Co. of Newtown Square, Pa., "This is the key to making prototyping successful: manage user expectations, manage the project to meet them and try to define and contain the project's scope up front."

Most of the responses to our question about managing iterations contained the word *difficult* or variations on *no*, indicating that managers routinely experience problems in this area. Perhaps as a result, roughly 30% of respondents imply that the completion of a prototype is a very subjective matter of tail-end negotiation rather than an up-front contract.

The average reported length of a prototype development effort, at 4.25 months, is longer than we expected, and can be partly explained by the time taken to accurately define data entities and relationships as part of the prototype effort. When asked whether prototyping reduces development time, 57% said yes. Another 22% reported that projects using prototyping took the same amount of time as those built without it. Another 18% had no opinion, saying they have no firm basis for comparison, since no project was done both ways. Only 3% said that prototyping takes more time, and this group also reported more iterations than was typical. Satisfaction with the resulting documentation and control was low, demonstrating that more attention is needed during development.

More Than Four Versions

We followed up with some of the companies that mentioned problems controlling the number of iterations and indicated that development tended to take place through more than four iterations. Interestingly, two companies stated that their projects were conducted by outside consultants. Although we cannot draw a correlation between number of iterations and outside contractors, we can certainly identify the potential for more iterations when the project is in the hands of outsiders. While this longer typical

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project length looks for all the world like a clear attempt on the part of contractors to extend projects and, thus, their own contracts, it was also the case that the outside contractors were usually handed very difficult applications in business areas with vague requirements.

In these cases, both external contractors and internal practitioners tend to prototype very small portions of the system, producing more numerous and frequent deliverables: systems by the slice.

Over the past decade, there have been countless articles about prototyping in professional journals. A preponderance described prototype projects as those that you do once, with the user right beside you. Therefore, the project comes out right the first time. Or, alternately, versions are developed successively until users accept one as the final system.

What follows from the first approach is that when users see what they can have, they experience a sort of systems enlightenment. Awake to the new possibilities, they begin formulating—albeit intelligently—more frequent requests for systems. The greater the initial success, the greater the requests. The inherent failure in the latter approach is that development may never really end. So, neither of these two approaches in itself offers the glamour of fast, accurate systems development—the original basis for proceeding with a prototype.

Our survey confirms that people employ these techniques partially, rather than exclusively, and that prototyping is more elastic than rigid. We see enlightened practitioners defining to clients the benefits and trade-offs of the possible approaches and then giving the choice and options back to the customer. Development strategy varies with the needs of each individual effort.

☐ PROTOTYPING IS BEING USED AS A WAY TO FULLY EXPLOIT FOURTH-GENERATION LANGUAGES AND DATA BASES.

Survey results show that prototyping is rapidly gaining acceptance in corporations throughout the country and that practitioners are not following any one particular theory. While the earliest predictions were that prototyping would help develop systems faster, we see a strong trend toward the use of prototyping as a way to produce a more accurate requirements set, which leads to systems closer to users' expectations. It is these close ties to users that are a hallmark of prototype development.

The problems with prototyping tend to relate to a lack of application of basic management methods. Yet, as IS strives to meet business needs, prototyping will continue to grow as a preference for faster, more accurate systems design and definition. ▭

J.M. Carey and J.D. Currey are project management professionals with over 40 years of combined IS experience. They consult for Carey Project Organization of Ardmore, Pa., specialists in management techniques and methods for applications delivery.

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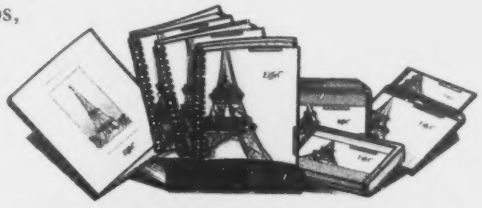

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Not Just the MacMaverick Anymore?

Some market share figures and news from state-of-the-art user sites suggest that IS managers are more willing than ever to embrace the Macintosh—but they still have a technology wish list for it.

BY BOB FRANCIS

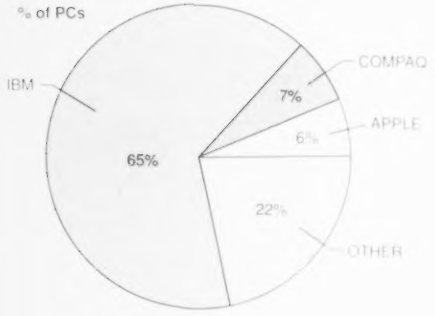
Whether it is a result of increased user sophistication in weaving together disparate systems or because of Apple Computer Inc.'s numerous new technology alliances, indications are that the Macintosh is becoming less of a bull maverick in the IS china shop and more of a welcome choice of IS managers.

"There are signs of a definite change," says Thomas Young, an analyst for the La Jolla, Calif.-based market research firm Computer Intelligence. "Although its market share in large corporations has not yet broken into double figures, and it's only a fraction of what IBM has, Apple is showing a steady gain. That's particularly interesting with a system that is incompatible with traditional MS-DOS desktop computing."

According to Young's analysis, Apple PCs currently represent 6% of all PCs gracing the desks of *Fortune* 1,000 U.S. corporations. This is up from 4% in April 1988, according to a previous survey. But, perhaps more important is the fact that Apple represents 9% of the purchases planned by those *Fortune* 1,000 companies through February 1990 (see charts). Figures from the DATAMATION/Cowen & Co. annual mini/micro survey (see "The Purchasing Outlook," November 15, 1988, p. 18) also predicted a slight

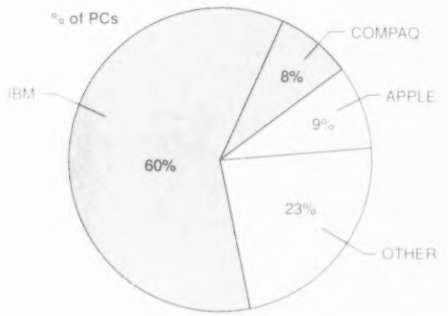
Which PCs Are Being Used Today

In 1989, Apple holds a 6% market share in *Fortune* 1,000 U.S. sites



Which PCs Will Be Used Tomorrow

Apple represents 9% of *Fortune* 1,000 PC purchases planned through February 1990



Source: Computer Intelligence

uptick in Apple's market share, from 7% of the survey's installed base in the summer of 1988 to 8% by the end of 1989. "I think that represents a clear change in attitude [toward Apple] among corporate information system directors," says CI's Young.

This change in attitude has made IS managers more inclined than ever before to pick the most appropriate technology for each application, rather than engage in a debate over vendors. "You can't tell where the new whiz-bang application is going to show up, and you can't just shut yourself out by standardizing on one architecture," says John White, senior vice president of information systems and services at Texas Instruments Inc. in Dallas. "That's just not going to happen again. If a good application comes along, we want to be ready to take advantage of it, no matter what platform it's on."

Officially, TI uses about 200 Macs, 120 of which are TI MicroExplorers, which are Mac IIs equipped with a TI Lisp chip. They are being used primarily for software development, mostly in stand-alone configurations.

The Corporate Push

This increased willingness to put an Apple in a Big Blue stable, for instance, may stem in part from Apple's amplified efforts to make it easier for the Macs to operate in a corporate IS environment by forging alliances with a number of other computer vendors (see sidebar). The companies Apple can count in its Mac technology circle today include Digital, IDEAssociates Inc., Tandem Computers Inc. and TI. To the same end, Apple also has acquired Network Innovations Corp. and Orion Network Systems Inc. Apple also has recently initiated a program to encourage independent Macintosh business software vendors to write new programs.

Apple's push for corporate acceptance was reflected at its first Macintosh Connectivity Conference held in March, which was an attempt to reach out to corporate users. Most recently, Apple has gone one step further—setting up a user organization it calls "MacIS," designed especially for *Fortune* 1,000 IS professionals.

Cheryl Currid, manager of departmental computing services at Coca Cola Foods, a Houston subsidiary of Coca Cola Co., says moves like this have increased Apple's appeal to corporate users. "What that said to us was that Apple is becoming a viable alternative product," she says. Coca Cola Foods currently uses IBM and IBM-compatible PCs but is looking into adding Apple products in the near future.

CBOT's BELDEN: Had to have a visually oriented machine

CI's Young believes that IBM has created a window, allowing Apple to make inroads into Blue and Blue-compatible territory, when it introduced the PS/2 line of PCs. Because the PS/2's Micro Channel Architecture looked like a return to the days of single-vendor closed systems, many IS managers stepped back to reevaluate the whole PC market, Young says. "The introduction of PS/2 sort of made it ridiculous for MIS to say 'We're an IBM-only shop' when IBM wasn't even compatible with IBM anymore," Young says. "Corporate information managers have had to look to other solutions than traditional PCs to solve some of their problems at the low end, and obviously Apple can do that for them in some cases."

TI's White agrees. "Nobody's going back to being a one-vendor shop any longer. MIS is not going to chose a product just because one company makes it and another doesn't."

Indeed, at Oakland, Calif.-based American President Companies Ltd., Macintoshes were the only viable alternative for a system critical to the company's operations, says Harold Cypress, a Los Angeles-based consultant at Arthur D. Little Inc., who helped install the system. "We realized very quickly that the typical 3270-like terminal would not meet the needs of both the system and the users involved," he says.

"We're using it for a system that's very

Photograph by Steve Leonard/Blackstar

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strategic, very important, for our company," says American President's James S. Marston, senior vice president and chief information officer at the containerized freight distribution and transportation company. Being installed in the company's primary distribution terminals worldwide, the Macintosh-based application uses a proprietary computer program called TACTICS (Tactical Container Terminal Information Control System), developed by company engineers.

With TACTICS, the Macintosh determines the best way to load ships with the company's containers. "This system, and the way it is going to be used, required the individual participants to deal with a number of displays simultaneously and to move information—both in text and graphical form—from one display to another for purposes of their own decision support and for passing information to others. Those requirements plus others clearly pointed to something that still doesn't exist today, but the Macintosh has come the closest," ADL's Cypress says.

Information is batch-loaded down from American President's IBM or Amdahl Corp. mainframes to the designated Macintosh fileserver. From there, other Macintoshes manipulate the material, making changes, and the new information is uploaded to the mainframes. Eventually, Marston wants to have the information running in real time on the Macintosh server. Currently, the Macintoshes are connected to the mainframes via 3270 emulation cards with a combination of coaxial and twisted pair cabling or an SNA (Systems Network Architecture) gateway device on an AppleTalk network. About 2,000 Apple computers are in use throughout the company. The TACTICS system, installed in Japan, Taiwan and the company's Seattle offices, will be expanded to many other locations by midsummer, company officials say.

Apple's Fruitful Alliances

Apple's alliances with TI and Tandem bore fruit in a system being developed by the Chicago Board of Trade (CBOT). "We're going to be using Mac for our 24-hour trading system that we'll be prototyping in September," says Glen Belden, CBOT vice president of information systems. The Macintosh machines will be connected to eight Tandem computers, used to replicate the board's pit style trading system after official business hours.

"We had to have something very visually oriented, and the Mac is a very powerful visual machine," Belden says, adding that, eventually, the CBOT system will use thousands of Macintoshes.

In designing the system, Belden used the product of the TI-Apple alliance—the TI MicroExplorer, a Macintosh II made into a low-cost artificial intelligence workstation by means of TI's Lisp chip. "I had used the Explorer [TI's Lisp workstation] before, but I decided to do this work on the MicroExplorer. So we used it to do a rapid prototyping of the application using standard programming techniques that would have taken anywhere from a year-and-a-half to two years. Here we did the specifications in two months and the simulation in another two months," Belden says.

The CBOT had already planned to make the Tandem connection itself, making Apple's agreement with Tandem a lucky fluke, Belden says. "That [agreement] assures us that the connectivity will work," he adds.

Other business-oriented technology for the Macintosh has emerged from companies that are not formally allied with Apple. IDEAssociates Inc. of Billerica, Mass., for example, produced the IDEAcomm Mac, a communications board linking the Macintosh SE with IBM minicomputers, which paid off for Bearing Belt and Chain Co., a distribution firm in Las Vegas and beta-test site for the product.

Bearing president Steve Philpott says it was a connection he had wanted to make for some time. "We've had Macs for about two years, and I always wanted to connect them. This gave me the chance to see how it would work, so now we use the Macs for inventory control, purchasing, messaging and the like. In addition, our System 36 gets data from our primary manufacturer's IBM mainframe, so we download that data from the mainframe to the System 36 and then to our Macs. If someone orders a part, we can check and see where it is in the manufacturing process," he reports.

Taming the MacMaverick

To further enhance the perception among IS managers that Apple Computer Inc.'s Macintosh personal computers can be successfully introduced into a business environment, Apple has made several moves in the last year. These include technical alliances and acquisitions designed to provide technology crucial to business.

In order of their appearance in the market, the technical alliances were with:

- Texas Instruments Inc., Dallas., March 1988. This agreement produced the TI MicroExplorer, an Apple II machine made into a low-cost artificial intelligence workstation via TI's Lisp chip.
- Digital Equipment Corp., Maynard, Mass., August 1988. Since nearly 40% of VAX sites also use Macs, the agreement was designed to spur more development among third-party manufacturers of peripherals and software. So far, however, no new products have been generated by the alliance.
- Tandem Computers Inc., Cupertino, Calif., September 1988. This agreement allows Tandem to sell Macs as part of the company's on-line transaction-processing (OLTP) network. In addition, Tandem also agreed to develop connectivity products for the Macintosh targeted at the OLTP market. Among those products will be local area networks, data base access software, terminal emulators, host interfaces and file/print service products, says Rich Mironov, Macintosh product manager for Tandem.

The companies Apple bought in order to acquire technology were:

- Network Innovations Corp., Cupertino, Calif., March 1988. The purchase gives Apple access to CL/1 communications software, a networking language for building applications that link Macintosh users to data bases on Digital minicomputers without users having to leave Mac applications. Eventually, CL/1 will provide some connectivity links between Macs and DOS, OS/2-based PCs and IBM mainframes, says Arthur D. Little Inc. consultant Harold Cypress.
- Orion Network Systems Inc., Berkeley, Calif., June 1988. Orion's primary product, which Apple had licensed in 1985, is a Systems Network Architecture (SNA) peer communications facility that allows the Mac to exchange information with IBM systems.
- Coral Software Corp., Cambridge, Mass., January 1989. Coral markets two versions of the Lisp programming language for the Macintosh—Allegro Common Lisp and Pearl Lisp.

Jennifer M. Jacobs, an associate at the consulting firm Boston Systems Group, says that the kind of vital, strategic Mac applications being developed at American President and CBOT will eventually make their way into large businesses. "In some ways, it's the traditional story of Apple in the organization: Macs come in with desktop publishing and then eventually move to other parts of an organization. But to move into a really strategic area—to have the blessing of MIS—that's going to take a while. You just don't change an attitude overnight," she says.

In fact, despite many of the changes that have taken place over the past year with Apple and the increased interest among some MIS managers toward the company's products, plenty of challenges must be met and mastered before Macs are truly welcomed into corporate America.

IS Directors' Wish List

For example, even though American President is purchasing more Macintoshes than IBM or IBM-compatible PCs, it doesn't mean Apple has done everything the company's IS officials would like to make their system work. American President's IS staff members "have a wish list, and I think it reflects a wish list that most IS directors would like to see filled by Apple," says ADL's Cypress. On that wish list are more tools, such as computer-aided software engineering (CASE) packages, for developing Macintosh applications not only on the microcomputer but also on mini- and mainframe computers; improved connectivity between the Apple and SNA worlds; and improved LAN support.

In fact, so far, no corporate applications have been developed that truly take advantage of the Mac's capabilities. Informix Corp.'s long-awaited Wingz spreadsheet software holds some promise, according to some early users, but it's far too early to tell how that product will fare in the marketplace. In addition, it is likely, given market realities, that most graphically oriented software for the Macintosh will ultimately be ported to an MS-DOS environment, either Windows or OS/2, or to some other UNIX-based application.

"There's sort of a window of opportunity for Apple, between the time OS/2 was announced and when Presentation Manager and OS/2 really begin to take hold in the market. Who knows when that will be?" says CI's Young.

Apple also may face increasing competition from Sun Microsystems Inc., which is offering the "Sparcintosh," a machine boasting many of the ease-of-use features of the Mac at a price that puts it in competition with the high end of the Macintosh line. But Apple has countered with AUX, its own version of UNIX, which allows the Mac to handle many of the computer-aided design tasks that formerly required high-powered workstations like Sun's.

☐ FOR AMERICAN PRESIDENT'S APPLICATION, THE MAC COMES CLOSEST TO REALIZING A TECHNOLOGY THAT DOESN'T YET EXIST.

Also, to make it more competitive with UNIX machines like Sun's, Apple is in the midst of rewriting its operating system so that it will be multitasking, like UNIX. "The workstation market may present some challenges, but that's also because Apple has always challenged it to some extent," says Jacobs of the Boston Systems Group.

While Apple appears to be rising to the occasion, corporate user wish lists for the Mac represent a tall order—especially for a company that until recently had consistently characterized itself as the maverick, firmly outside the Business Establishment. Early in the life of the corporation, in fact, Apple almost refused to acknowledge IBM, much less consider connecting its systems to any Blue machines. That was in 1983, when Apple was touting the Lisa computer as the solution to business needs. Things are a little different at Apple now, company officials admit.

"When we did Lisa, we were a little bit naive," admits Michael J. Homer, director of marketing at Apple U.S.A. Division. But, he adds, Apple learned a lot from the experience. "I think one thing that is different now is that we do have a mature architecture. The Lisa was an important idea. We took many of the notions around intuitive PCs and built them into a system that was not acceptable for a variety of reasons. Then we came back in 1984 and did the Macintosh. That's been the basis of our success ever since."

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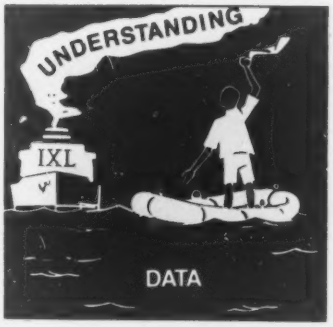

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